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US005197420A

# United States Patent [19]

Arnold et al.

[11] Patent Number: 5,197,420  
[45] Date of Patent: Mar. 30, 1993

[45] Date of Patent: Mar. 30, 1993

## [54] CAMSHAFT ADJUSTER AND TENSIONER

[75] Inventors: Gerd Arnold, Nauheim; Markus Lienkamp, Bad Schwalbach; Albert Schweikard, Appenheim, all of Fed. Rep. of Germany

[73] Assignee: General Motors Corporation, Detroit,  
Mich.

[21] Appl. No.: 803,514

[22] Filed: Dec. 16, 1991

**[30] Foreign Application Priority Data**

Dec. 24, 1990 [DE] Fed. Rep. of Germany ..... 4041785

[51] Int. Cl. .... FOIL 1/34; FOIL 1/04  
[52] U.S. Cl. .... 123/90.15; 123/90.31;

[58] Field of Search ..... 123/90.15, 90.17, 90.31;  
474/110, 111, 117, 138

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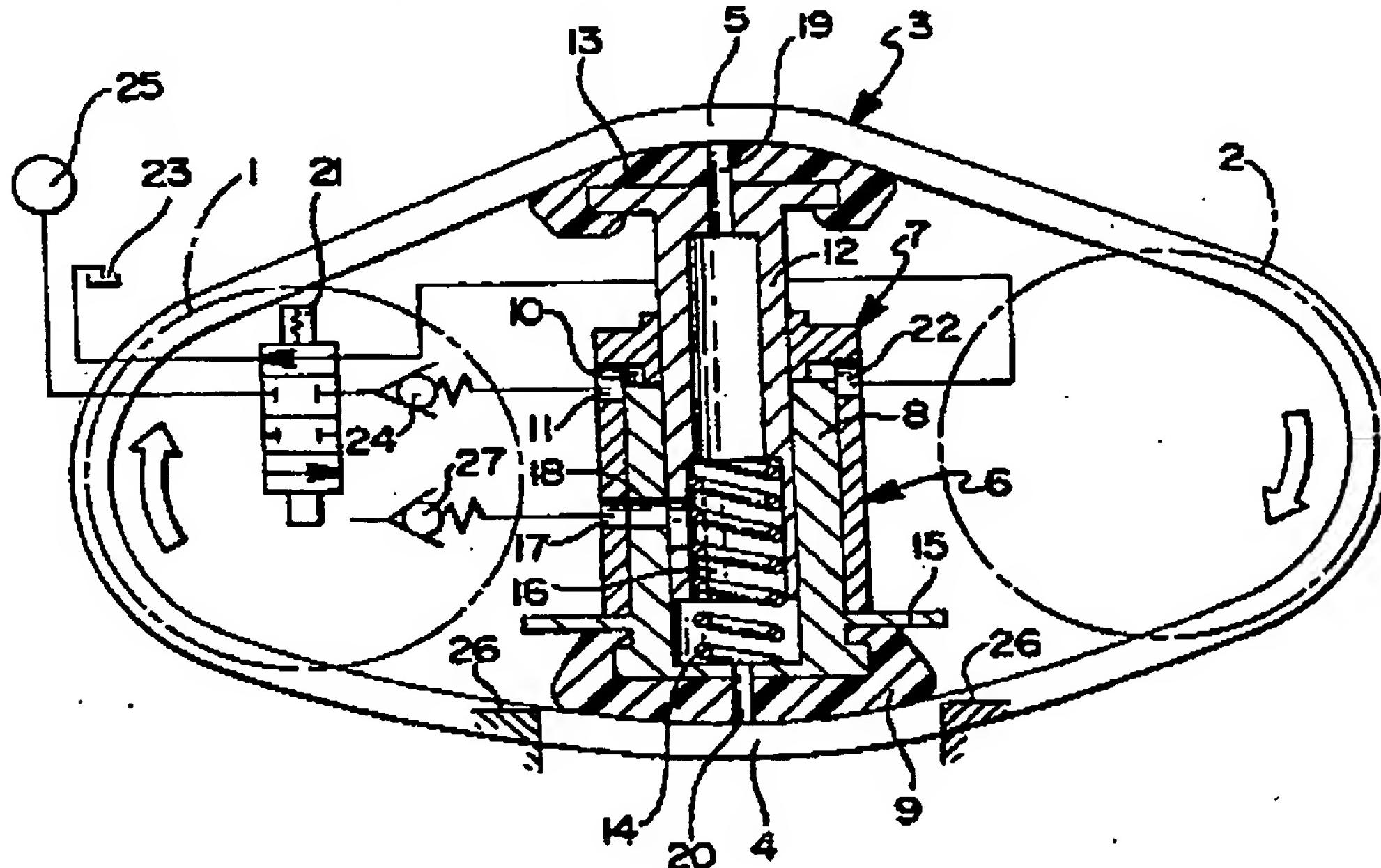
Porsche 968, *Automotive Engineering*, Nov. 1991, pp. 73-74.

*Primary Examiner*—E. Rollins Cross  
*Assistant Examiner*—Weilun Lo  
*Attorney, Agent, or Firm*—Robert J. Outland

## **ABSTRACT**

A camshaft adjuster mounted between a taut strand and a slack strand of a chain connecting an intake camshaft to an exhaust camshaft has two tensioning shoes which are urged by a spring away from each other and against the inner sides of the chain strands. One tensioning shoe is mounted on a reciprocable piston within which a plunger carrying the other tensioning shoe is slidable against the force of the spring. The piston is moved against the taut strand by pressurization of a pressure chamber through a nonreturn valve and the plunger is moved with the piston so that the taut and slack strands are moved together and compression of the tensioning spring is thereby maintained relatively constant. A damping chamber may be provided with throttling bores in the piston and/or plunger to control the damping effect.

8 Claims, 1 Drawing Sheet





US006363896B1

(12) **United States Patent**  
**Speier**

(10) Patent No.: US 6,363,896 B1  
(45) Date of Patent: Apr. 2, 2002

**(54) CAMSHAFT ADJUSTER FOR INTERNAL COMBUSTION ENGINES**

(56) References Cited

## U.S. PATENT DOCUMENTS

(75) Inventor: Wolfgang Speier, Stuttgart (DE)

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(21) Appl. No.: 09/673,772

DE	40 29 849	3/1991
DE	39 37 644	5/1991
DE	196 11 365	9/1997
DE	197 26 300	1/1998
WO	92/20906	11/1992

(22) PCT Filed: Apr. 14, 1999

8371 Date: Jul 5 2001

§ 102(e) Date: Jul 5 2001

(87) PCT Pub. No.: WO99/54599

PCT Pub Date: Oct 28 1999

(30) Foreign Application Priority Data

Am. 18. 1998 (DE) ..... 198 17 319

(S1) Int Cl<sup>7</sup> FOIL 1/344

(52) U.S. Cl. .... 123/90.17; 74/568 R

(58) Field of Search ..... 123/90.15, 90.17,  
123/90.31; 74/568 R; 464/1, 2, 160

**FOREIGN**

DE	40	29
DE	39	37
DE	196	11
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WO	92	2

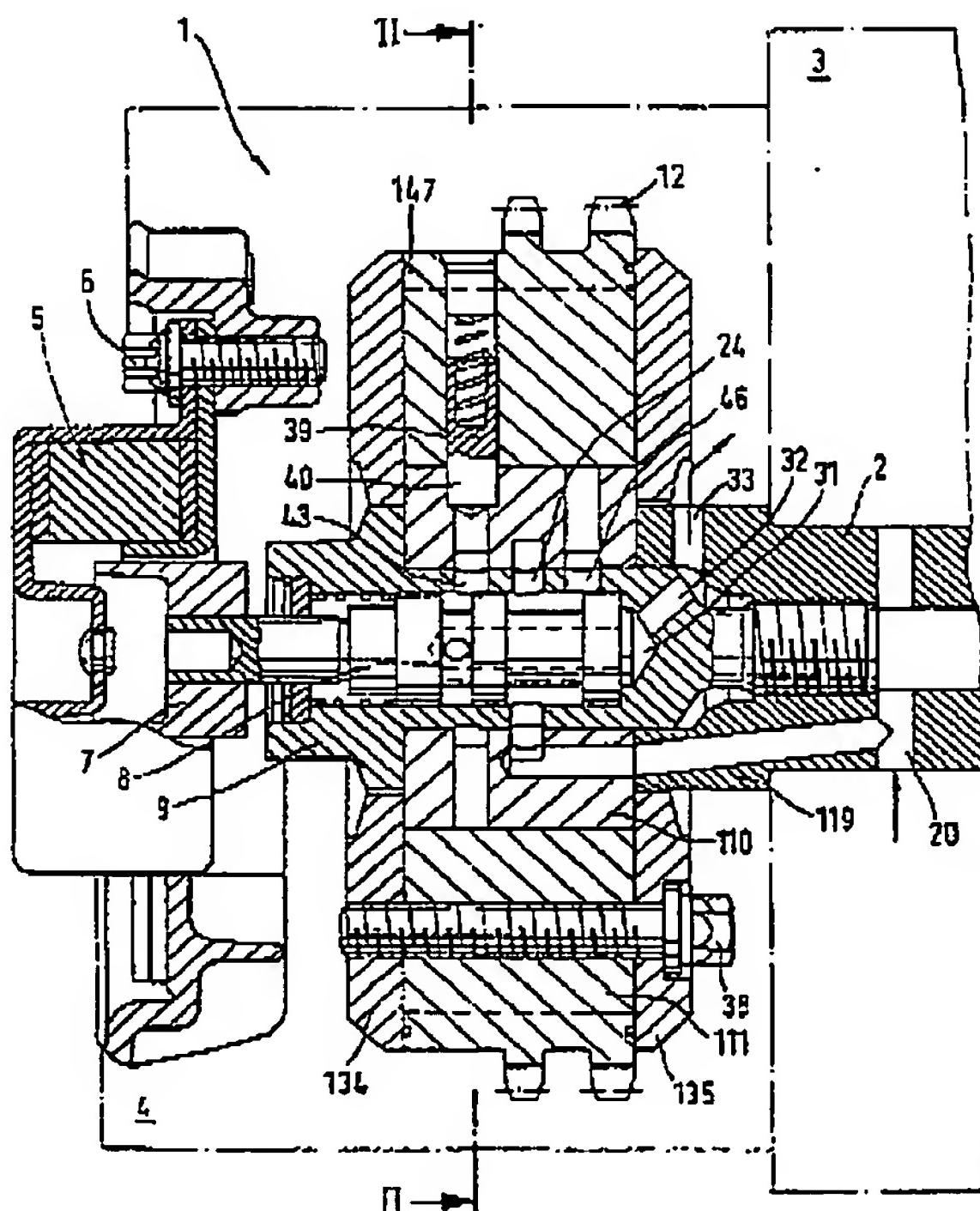
\* filed by examiner

*Primary Examiner—Weilun Lo  
(74) Attorney, Agent, or Firm—Kenyon & Kenyon*

(57) ABSTRACT

A camshaft adjuster (1) for internal combustion engines has a central tensioning screw (9) for fixing the adjuster (1) in relation to a camshaft (2). A slide (8) controls the supply of the pressure medium to the camshaft adjuster (1) being integrated into the tensioning screw (9). The tensioning screw (9) forms the mounting of the camshaft adjuster (1) in relation to the camshaft (2).

**4 Claims, 3 Drawing Sheets**





US006675752B1

(12) **United States Patent**  
Kunne et al.

(10) Patent No.: **US 6,675,752 B1**  
(45) Date of Patent: **Jan. 13, 2004**

(54) INTERNAL COMBUSTION ENGINE WITH HYDRAULIC CAMSHAFT ADJUSTER FOR ADJUSTING THE CAMSHAFT

6,032,629 A • 3/2000 Uchida ..... 123/90.34  
6,129,063 A • 10/2000 Niethanmier et al. .... 123/90.17  
6,244,230 B1 • 6/2001 Mikame ..... 123/90.17

(75) Inventors: Ernst-Andreas Kunne, Schwilper (DE); Andreas Knecht, Kusterdingen (DE)

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(73) Assignee: Volkswagen AG, Wolfsburg (DE)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/088,453**

(22) PCT Filed: **Sep. 12, 2000**

(86) PCT No.: **PCT/EP00/08904**

§ 371 (c)(1),  
(2), (4) Date: **Mar. 13, 2002**

(87) PCT Pub. No.: **WO01/20135**

PCT Pub. Date: **Mar. 22, 2001**

## (30) Foreign Application Priority Data

Sep. 13, 1999 (DE) ..... 199 43 833  
(51) Int. Cl. 7 ..... F01L 1/34  
(52) U.S. Cl. ..... 123/90.17; 123/90.15;  
123/90.16; 123/90.27; 464/160  
(58) Field of Search ..... 123/90.15, 90.16,  
123/90.17, 90.18, 90.27, 90.31, 90.34; 464/1,  
2, 160

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Primary Examiner—Thomas Denion

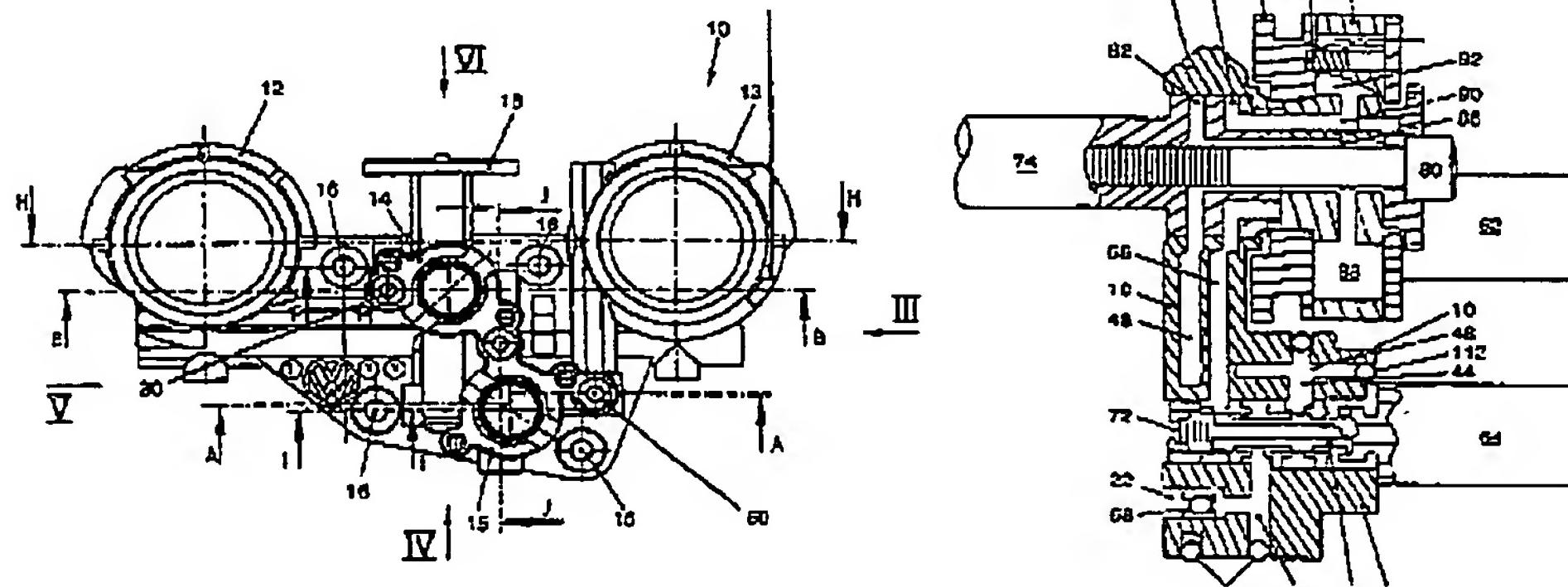
Assistant Examiner—Ching Chang

(74) Attorney, Agent, or Firm—Ostrolenk, Faber, Gerb &amp; Soffen, LLP

## (57) ABSTRACT

An internal combustion engine including a cylinder head having gas-exchange valves, at least one camshaft supported on the cylinder head, which camshaft is driven by a crankshaft to actuate corresponding gas-exchange valves on the cylinder head, and a camshaft adjuster arranged on the camshaft. The adjuster has a hydraulic pressure chamber and is configured to use hydraulic pressure to rotate position of the camshaft relative to the crankshaft to change control times of the gas-exchange valves. A feed device for hydraulic pressure is provided on the camshaft adjuster and is configured as a component separate from the cylinder head. The feed device has a ring for each camshaft, each ring having two grooves, each of the grooves being connected via associated hydraulic pressure channels in the feed device to a hydraulic pressure valve. Each ring is arranged to surround a section of the camshaft. Each surrounded section of the camshaft has two ring-shaped grooves, each of which is aligned with one of the grooves of the corresponding ring to form a pair. Each groove/ring-shaped groove pair of a ring is connected via associated hydraulic pressure channels in the camshaft to the hydraulic pressure chamber of the camshaft adjuster mounted on the camshaft.

5 Claims, 16 Drawing Sheets



[Search](#)    [911](#)    [911 Carrera S](#)    [911 Carrera Cabriolet](#)    [911 Carrera S Cabriolet](#)    [911 Targa](#)    [911 Carrera 4S](#)    [911 Carrera 4S Cabriolet](#)    [911 Turbo](#)    [911 Cabriolet](#)    [911 Turbo S](#)    [911 Cabriolet](#)    [911 Turbo S Cabriolet](#)    [911 GT3](#)    [911 GT2](#)

# Engine and Transmission

## Engine diagram

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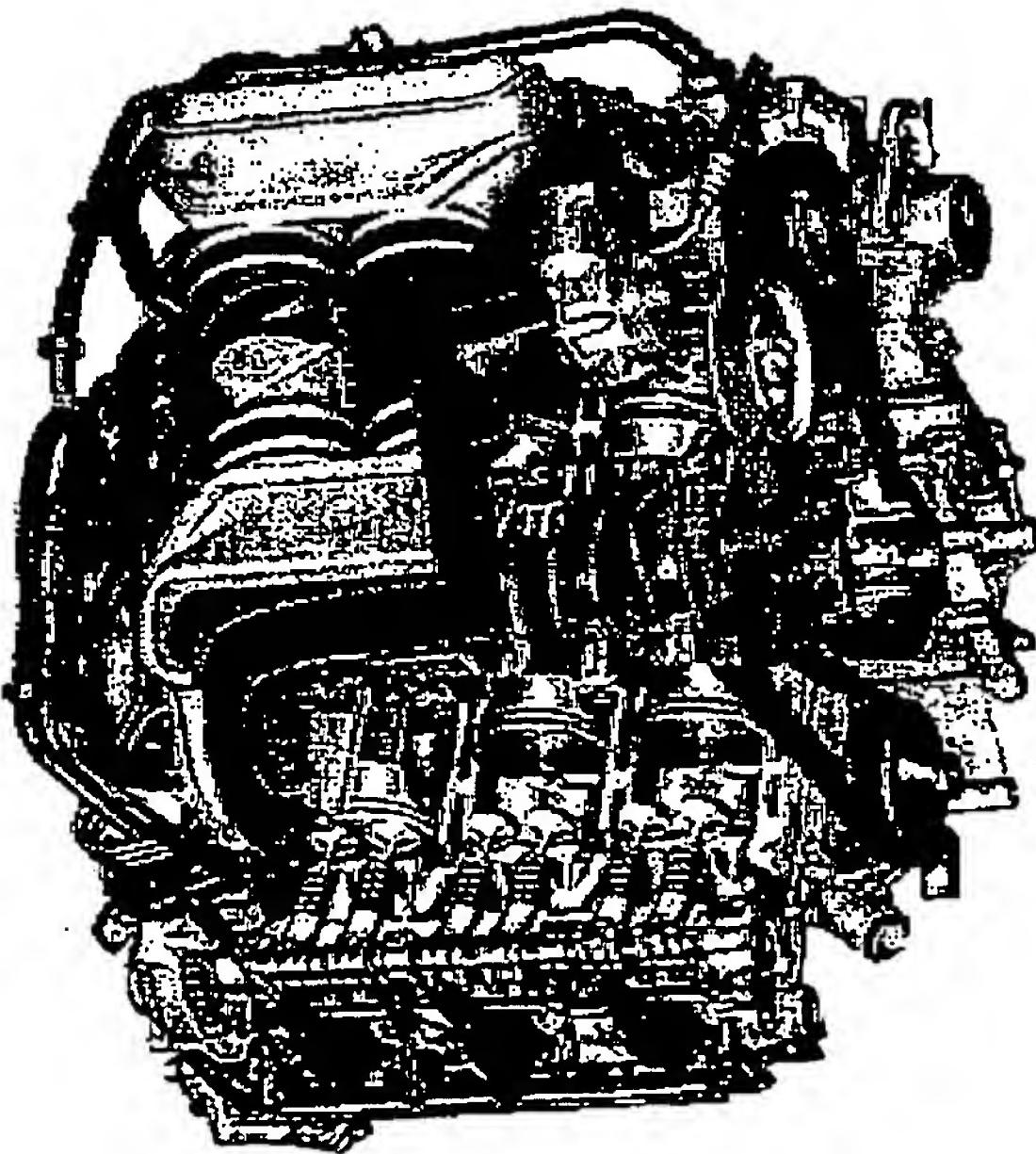
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### Legend 1

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Engine: 911 Carrera S

Porsche Protection is a registered trademark of Porsche Automobil Holding SE.



(12) **United States Patent**  
Niethammer et al.

(10) Patent No.: **US 6,390,043 B1**  
(45) Date of Patent: **May 21, 2002**

(54) **DEVICE FOR HYDRAULICALLY ADJUSTING THE ANGLE OF ROTATION OF A SHAFT IN RELATION TO A DRIVING WHEEL**

5,215,046 A 6/1993 Obata et al. .... 123/90.17  
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6,085,708 A \* 7/2000 Trzmiel et al. .... 123/90.17

(75) Inventors: Bernd Niethammer, Nurtingen; Andreas Knecht, Ammerbuch, both of (DE)

(73) Assignee: Dr. Ing.H.C.F. Porsche AG, Weissach (DE)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/674,707

(22) PCT Filed: Apr. 14, 1999

(86) PCT No.: PCT/EP99/02504

§ 371 Date: Jan. 26, 2001

§ 102(e) Date: Jan. 26, 2001

(87) PCT Pub. No.: WO99/57423

PCT Pub. Date: Nov. 11, 1999

(30) Foreign Application Priority Data

May 5, 1998 (DE) ..... 198 19 995

(51) Int. Cl. 7 ..... F01L 1/344

(52) U.S. Cl. ..... 123/90.17; 74/568 R

(58) Field of Search ..... 123/90.15, 90.17,

123/90.31; 74/568 R; 464/1, 2, 160

(56) References Cited

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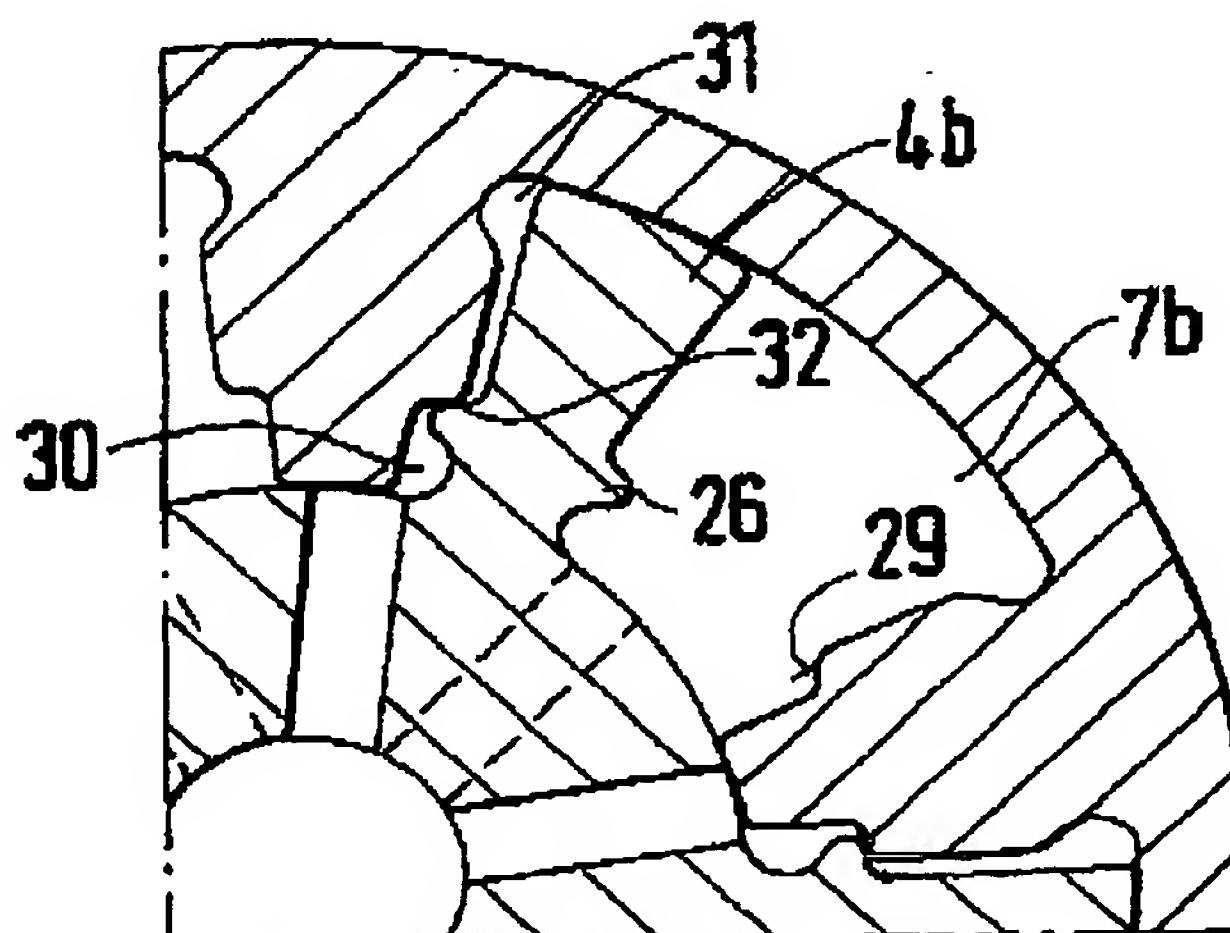
Primary Examiner—Welton Lo

(74) Attorney, Agent, or Firm—Crowell & Moring LLP

(57) ABSTRACT

A device for changing the angle of rotation of a camshaft of an internal combustion engine relative to a driving wheel. The device includes an inner part, which is provided with bridges or wings, and is disposed rotationally movable in a cell wheel. The driven cell wheel has several bridges, which are distributed over the periphery and divided by bridges or wings of the inner part into in each case two pressure spaces. The change in the angular position is caused by applying pressure on or relieving pressure from the two pressure spaces. As an end position is approached, the adjusting movement is damped hydraulically by integrated damping means. These damping means are formed by the interaction of the mutually approaching bridges of the inner part and of the cell wheel.

5 Claims, 3 Drawing Sheets





US006209497B1

(12) **United States Patent**  
Niethammer et al.

(10) Patent No.: **US 6,209,497 B1**  
(45) Date of Patent: **Apr. 3, 2001**

(54) **DEVICE FOR CHANGING THE RELATIVE ROTATIONAL POSITION OF A SHAFT TO THE DRIVE WHEEL**

(75) Inventors: Bernd Niethammer, Nuertingen; Andreas Knecht, Ammerbuch, both of (DE)

(73) Assignees: Dr. Ing. h.c.F. Porsche Aktiengesellschaft, Stuttgart; Hydraulik Ring GmbH, Nuertingen, both of (DE)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/463,447

(22) PCT Filed: Apr. 14, 1999

(86) PCT No.: PCT/EP99/02505

§ 371 Date: Apr. 4, 2000

§ 102(e) Date: Apr. 4, 2000

(87) PCT Pub. No.: WO99/61759

PCT Pub. Date: Dec. 2, 1999

(30) Foreign Application Priority Data

May 27, 1998 (DE) 198 23 619

(51) Int. Cl. 7 F01L 1/344

(52) U.S. Cl. 123/90.17; 123/90.31;

74/568 R; 464/2; 464/160

(58) Field of Search 123/90.15, 90.17, 123/90.31; 74/568 R; 464/1, 2, 160

(56) References Cited

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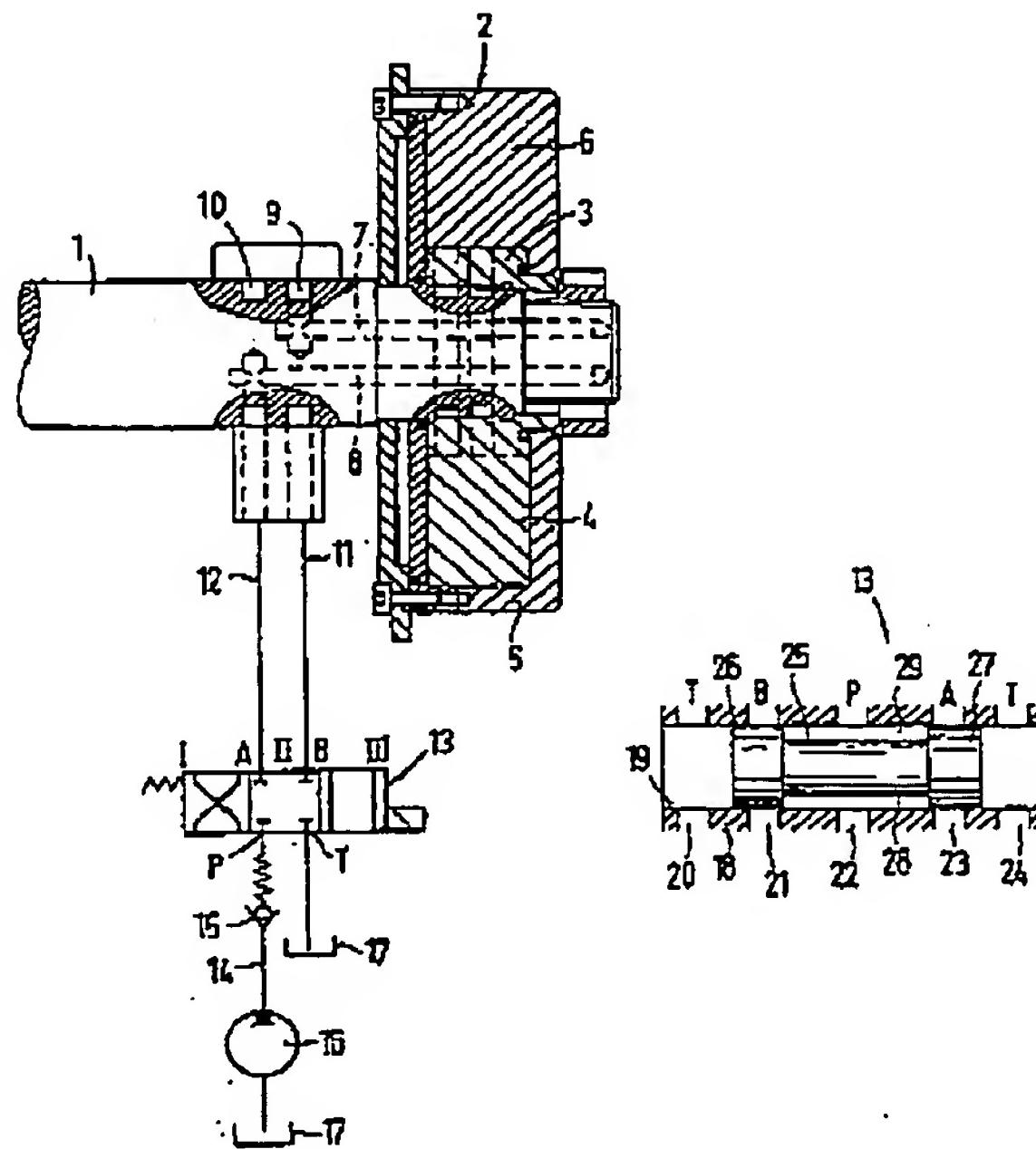
Primary Examiner—Weilun Lo

(74) Attorney, Agent, or Firm—Evenson, McKown, Edwards & Lenahan, PLLC.

(57) ABSTRACT

The system according to the invention for the relative rotating position change of a shaft with respect to a driving wheel has an adjusting device with two pressure spaces which act against one another and which can be acted upon by a pressure medium pump. In order to achieve a uniform controlled adjusting operation and a secure position fixing, the pressure space connected with the pressure medium pump is acted upon by pressure at the start of the adjusting movement before the opposite pressure space connected with the pressure medium tank is relieved.

15 Claims, 1 Drawing Sheet





US006129063A

**United States Patent [19]**  
**Niethammer et al.**

[11] Patent Number: **6,129,063**  
[45] Date of Patent: **Oct. 10, 2000**

[54] **DEVICE FOR CHANGING THE ROTATIONAL POSITION OF A SHAFT RELATIVE TO A DRIVE WHEEL AND METHOD OF MAKING SAME**

5,937,810 8/1999 Sato et al. .... 123/90.17

[75] Inventors: Bernd Niethammer, Nuertingen; Andreas Knecht, Ammerbuch, both of Germany

**FOREIGN PATENT DOCUMENTS**

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197 45 908 4/1999 Germany

[73] Assignee: Dr. Ing. h.c.F. Porsche AG, Weissach, Germany

[21] Appl. No.: 09/359,433

[22] Filed: Jul. 22, 1999

**Foreign Application Priority Data**

Aug. 1, 1998 [DE] Germany ..... 198 34 843

[51] Int. Cl. ? F01L 1/344

[52] U.S. Cl. 123/90.17; 123/90.31;

74/568 R; 464/2

[58] Field of Search 123/90.15, 90.17, 123/90.31; 74/568 R; 464/1, 2, 160

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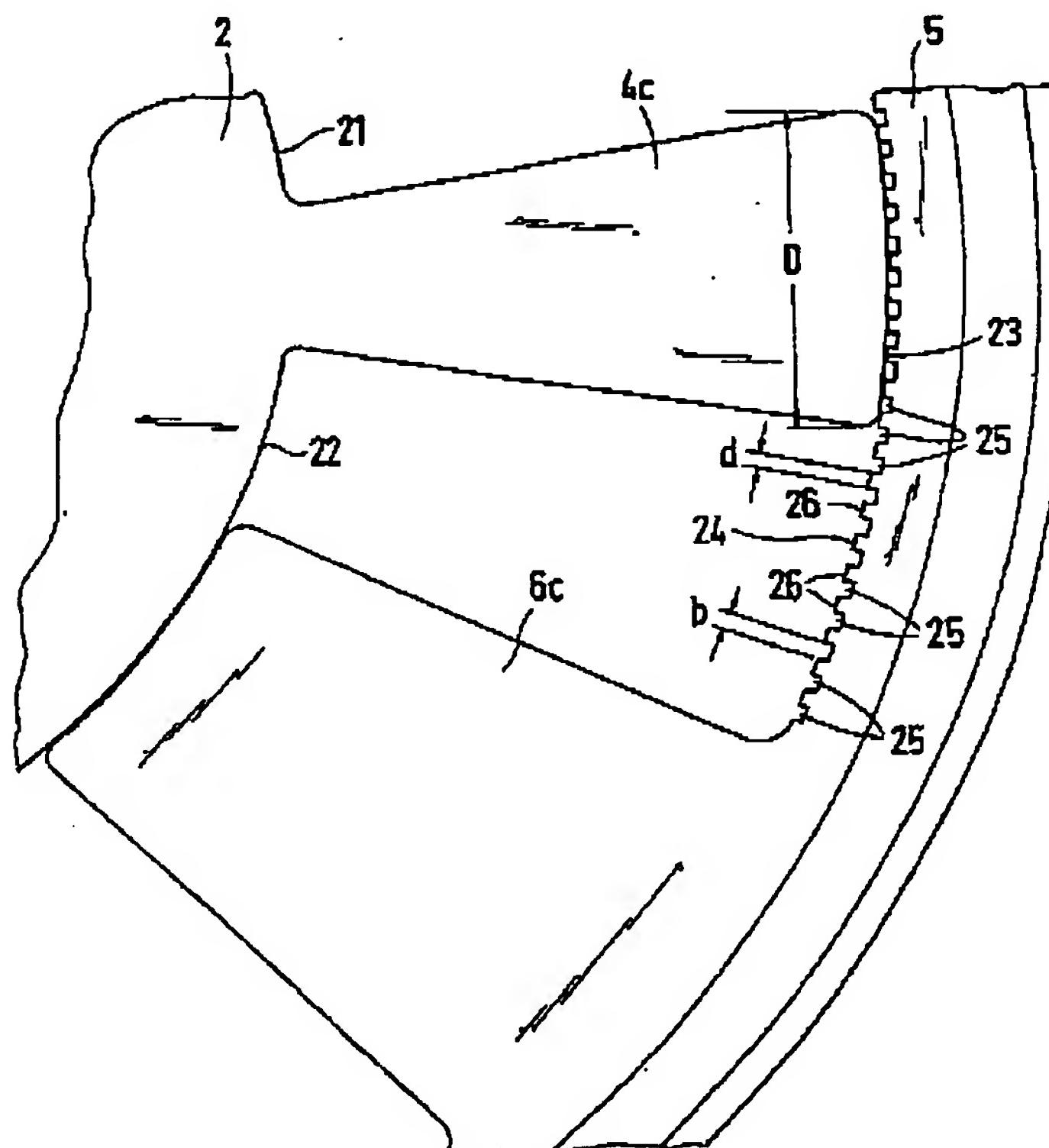
*Primary Examiner—Weilun Lo*

*Attorney, Agent, or Firm—Evenson, McKeown, Edwards & Lenahan, PLLC*

**ABSTRACT**

A device for changing the rotational position of a shaft relative to a drive wheel has an adjusting device with two pressure chambers that act against one another. The chambers are pressurized by a pressure medium pump. The adjusting device includes an inner part with ribs that divides the chambers formed by the ribs of a compartmented wheel into corresponding pressure chambers. A plurality of depressions extending axially are machined into the circumferential surfaces of the compartmented wheel that faces the ribs of the inner part, which depressions serve to collect dirt particles carried by the pressure medium into the pressure chambers.

**22 Claims, 3 Drawing Sheets**





US006053138.A

**United States Patent [19]**

Trzmiel et al.

[11] Patent Number: **6,053,138**  
 [45] Date of Patent: **Apr. 25, 2000**

[54] DEVICE FOR HYDRAULIC ROTATIONAL ANGLE ADJUSTMENT OF A SHAFT RELATIVE TO A DRIVE WHEEL

[75] Inventors: Alfred Trzmiel, Grafenberg; Wolfgang Stephan, Boll; Axel-Wilhelm Jochim, Nuertingen, all of Germany

[73] Assignees: Hydraulik Ring GmbH; Dr. Ing. h.c.F. Porsche AG, both of Germany

[21] Appl. No.: 09/213,758

[22] Filed: Dec. 17, 1998

**[30] Foreign Application Priority Data**

Dec. 17, 1997 [DE] Germany ..... 197 56 015

[51] Int. CL<sup>7</sup> ..... F01L 1/344

[52] U.S. Cl. ..... 123/90.17; 123/90.31; 74/568 R; 464/2

[58] Field of Search ..... 123/90.12, 90.15, 123/90.17, 90.31; 74/568 R; 464/1, 2, 160

**[56] References Cited****U.S. PATENT DOCUMENTS**

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5,826,552	10/1998	Noguchi et al.	.....	123/90.17

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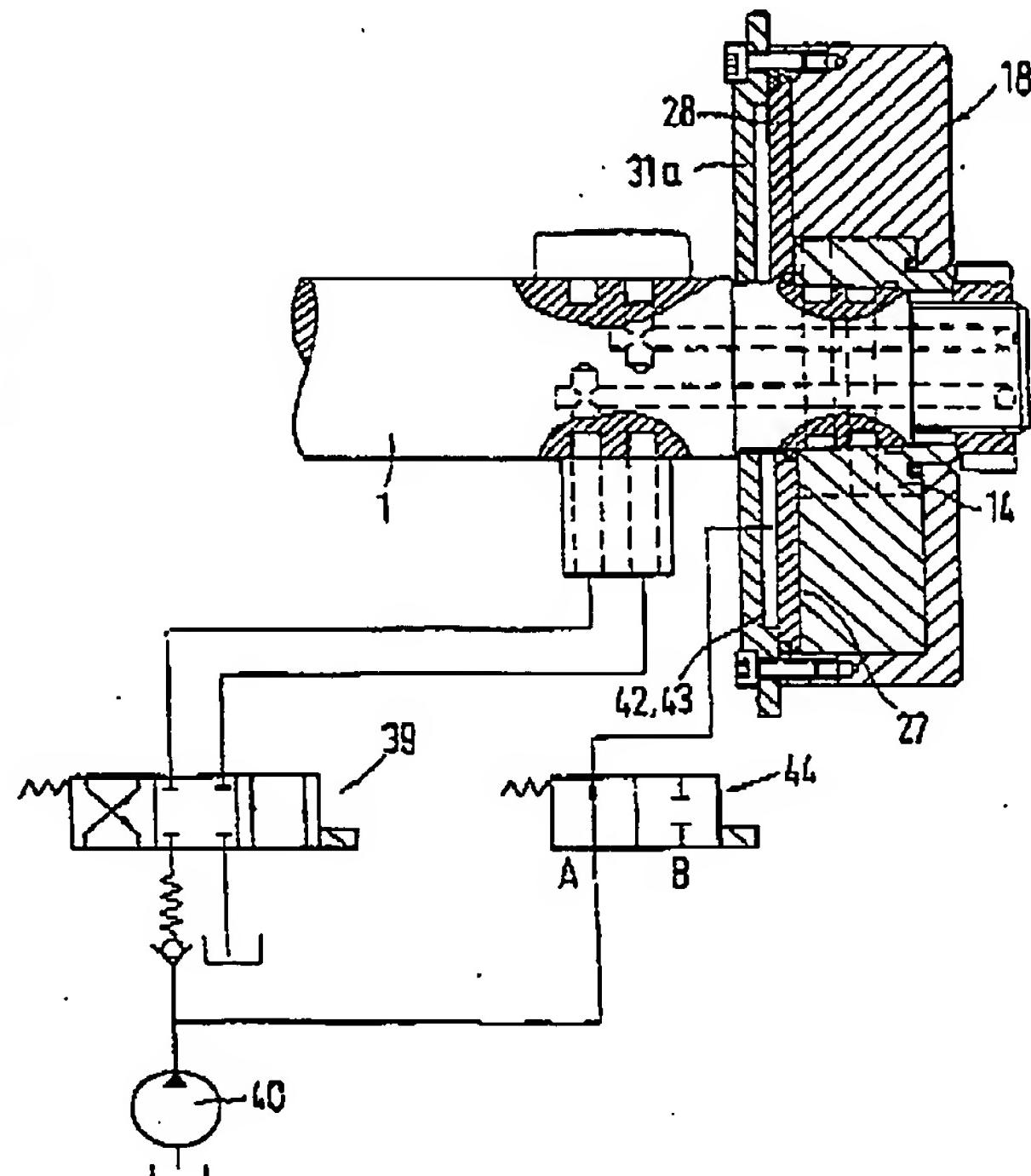
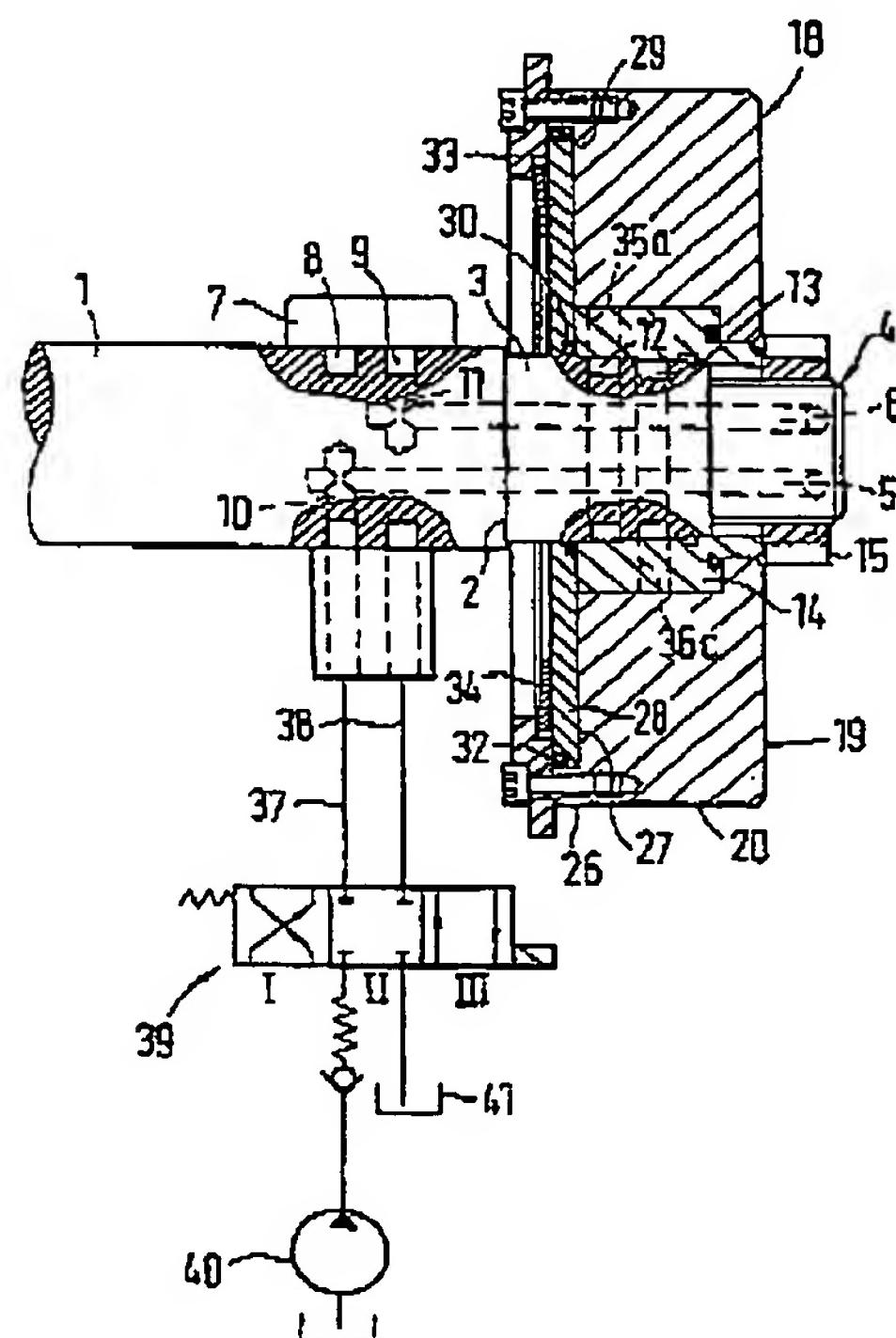
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4233250	1/1994	Germany
2302391	1/1997	United Kingdom
2314402	12/1997	United Kingdom

Primary Examiner—Welluo Lo  
 Attorney, Agent, or Firm—Evenson, McKeown, Edwards & Lenahan, P.L.L.C.

**[57] ABSTRACT**

A device for hydraulic rotational angle adjustment of a shaft to a drive wheel, especially the camshaft of an internal combustion engine, has ribs or vanes that are nonrotatably connected with the shaft, said ribs or vanes being located in the compartments of a compartmented wheel. The compartments of the compartmented wheel and the ribs and/or vanes produce pressure chambers by whose hydraulic pressurization the two structural elements can be rotated relative to one another. In order to secure the two structural elements against undesired rotation when an insufficient adjusting or retaining pressure is present, a common end face of the compartmented wheel and of the ribs and/or vanes cooperates with an annular piston that exerts a releasable clamping action on the parts that are rotatable relative to one another.

20 Claims, 3 Drawing Sheets



**Plant Layout/ Auto Piping**      **Valves & Fittings**      **Hydraulic Cartridge Valve**  
 Rapid 3D Plant Concept Models & Ball, Gate, Stop & Angle Valve, A full line of 5,000 psi hydraulic  
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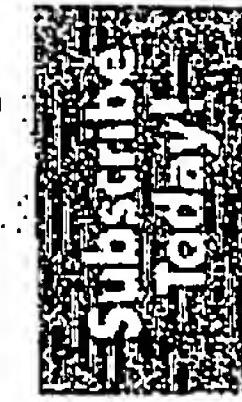
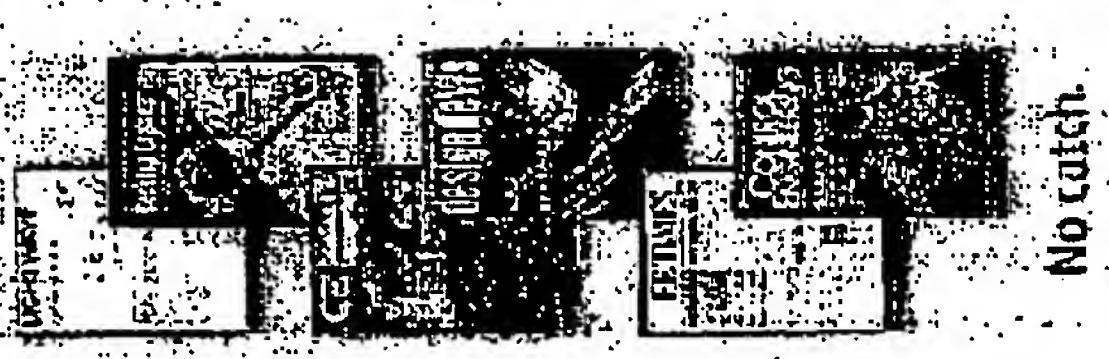
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- Heat Loss & Insulation
- Pressure Ratings
- Temperature Expansion
- Valve Standards

## Valves - Types

### Classifications of valves

Categories of Valves	Application Description
Flow regulating valves	For controlling rate of flow.
Temperature regulating valves	For controlling fluid temperature in a system.
Automatic process control valves	For controlling rate of flow relative to valve.
Anti vacuum valves	An automatic type of air valve preventing the formation of vacuum in tanks or pipelines.
Blow down valves	A valve which is used for cleaning sludge from a boiler.
Bulkhead valves	A gate valve.
Free ball valves	A valve in which a ball is free to rotate in any direction.
Fusible link or fire valves	A fire preventiuon valve which has a weighted lever hold open by a wire and fusible link which melts at an

	increase of room temperature.
Hydraulic valves	A control valve for water, oil, or hydraulic systems.
Jet dispersal valve	A valve incorporating an element by virtue of which the energy within the emitting jet is dissipated.
Penstock	A single faced type of valve consisting of an open frame and a door and used in terminal positions only. Normal located in tanks or channels for controlling flow in to a pipe.
Plate valves	A gate valve incorporating a sluicing effect.
Radiator valves	A valve controlling the flow of water through a radiator.
Rotary slide valve	A valve in which a rotation of internal parts regulates flow by opening or closing a series of segmental ports.
Rotary valve	A spherical plug valve in which the plug, which rotates through 90°.
Solenoid valve	A valve operated by an electrical solenoid.
Spectacle eye valve	A parallel slide valve.
Thermostatic mixing valve	A valve which combines temperature.
Throttle valve	A non tight closing butterfly valve.



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piston pin  
piston ring  
piston rod

**Main Entry:** **piston**

**Pronunciation:** 'pis-t&n

**Function:** noun

**Etymology:** French, from Italian *pistone*, from *pistare* to pound, from Old Italian, from Medieval Latin, from Latin *pistus*, past participle of *pinseare* to crush -- more at PESTLE  
**1** : a sliding piece moved by or moving against fluid pressure which usually consists of a short cylinder fitting within a cylindrical vessel along which it moves back and forth

**2** **a** : a sliding valve moving in a cylinder in a brass instrument which when depressed by a finger knob serves to lower the instrument's pitch **b** : a button on an organ console to bring in a previously selected registration

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